nitride layer at a thickness of 3 μm or more on the surface and then applied with finishing to a surface roughness of 0.1μm Ra or less.

6. (New) A rolling bearing as claimed in Claim 1, wherein the amount of Si is 0.10% by weight or more and the amount of Mn is 0.15% by weight or more.

7. (New) A rolling bearing as claimed in Claim 2, wherein the amount of Si is 0.10% by weight or more and the amount of Mn is 0.15% by weight or more.

8. (New) A rolling bearing as claimed in Claim 3, wherein the amount of Si is 0.10% by weight or more and the amount of Mn is 0.15% by weight or more.

9. (New) A rolling bearing as claimed in Claim 4, wherein the amount of Si is 0.10% by weight or more and the amount of Mn is 0.15% by weight or more.

10. (New) A rolling bearing as claimed in Claim 5, wherein the amount of Si is 0.10% by weight or more and the amount of Mn is 0.15% by weight or more.--

REMARKS

First, Applicants would like to thank the Examiner for the kind allowance of Claim 3. The Examiner will note that Claim 3 has been amended merely to correct a grammatical error. This claim stands allowed.

Claims 2 and 4 have been amended to indicate that the amount of residual austenite over the entire cross section of the element in question (the one of the inner ring, the outer ring, and the rolling element in Claims 1 and 2; the one of the inner ring and the outer ring in Claim 4) is 0% by volume.

New Claims 5-10 have been inserted to round out the coverage to which Applicants are entitled. Claim 5 is identical to Claim 3, but includes the further limitation that the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume. Claim 5 is, on its face, allowable. Claims 6-10, depending from Claims 1-5, respectively, each define a numerical lower limit of the amount of silicon and manganese in the alloy. Support for Claims 6-10 will be found at pages 5 and 6 of the originally filed specification. The amendments do not introduce new matter.

The Examiner rejected Claim 1 under 35 U.S.C. § 102(b) as anticipated by Matsumoto et al. and rejected Claims 2 and 4 under 35 U.S.C. § 103(a) as unpatentable over Matsumoto et al.. The Examiner took the position that Matsumoto discloses all that is being claimed in Claim 1. The Examiner considers Matsumoto et al. to render obvious the rolling element and outer ring having different compositions as recited in Claim 2 and considers Matsumoto et al. to render obvious the rolling element formed of ceramics. With respect to Claims 1 and 2, the Examiner commented

that the rejections over Matsumoto et al. are appropriate because the recited amounts of Si and Mn could be zero. These rejections are respectfully traversed.

Matsumoto, et al.:

Matsumoto, et al. disclose a rolling bearing wherein at least one of a bearing ring and a rolling element is formed of an alloy steel. The hardness of a surface layer over a thickness corresponding to greater than 2% of the mean diameter of a rolling element is equal to or greater than 60 HRC. Carbides of equal to or greater than 6 μm converted as the diameter of a circle are not contained in a range from the raceway surface or the rolling contact surface as far as the depth corresponding to 2% of the mean diameter of the rolling element.

The average concentration of residual austenite in at least one of the bearing ring and the rolling element of Matsumoto, et al. is less than 10% by volume. The average concentration of residual austenite in at least one of the bearing ring and the rolling element is less than 10% by volume. The average concentration of the residual austenite is defined to be less than 10% by volume so that the dimensional stability of the rolling bearing is equivalent with or superior to that of bearing steel No. 2 (SUJ-2).

In the present invention, at least one of an inner ring, an outer ring and a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring, the outer ring and the rolling element is 0% by volume and a surface hardness is HRC of 62 or more.

In the present invention, the amount of residual austenite over the entire cross section of at least one of the inner ring, the outer ring and the rolling element is 0% by volume, so that the dimensional change of the rolling bearing by martensitic transformation is removed to improve the rotational accuracy of the rolling bearing and the impact absorbing energy is increased. Also, even if the amount of residual austenite over the entire cross section of at least one of the inner ring, the outer ring and the rolling element is 0% by volume, since the surface hardness is HRC of 62 or more, the impact resistance of the bearing is improved so that the acoustic life is improved and the rolling fatigue life is extended.

The amount of the residual austenite in the raceway ring or the rolling element of the present invention is 0% by volume over the entire cross section of the raceway ring or the rolling

element. On the other hand, the concentration of the residual austenite in the raceway ring or the rolling element of the cited reference is 10% by volume or less using the mean value from the front surface to the back surface.

In Matsumoto, et al., the average concentration of the residual austenite (% by volume) in the outer ring was measured after the heat treatment and the measurement results are shown in Table 7. Also, Fig. 9 shows, based on the results of Table 7, a relationship between the concentration of the residual austenite and the position (A-B) along the direction of the thickness in the cross section of the outer ring.

As shown in Fig. 9 of Matsumoto, et al., the concentration of the residual austenite is higher at the surface and lower at the inside of the outer ring. Concretely, the concentration of the residual austenite is about 23% by volume at the surface A and is about 2 to 3% by volume at the inside of the outer ring. As a result, the average concentration of the residual austenite is about 6.4% by volume.

Matsumoto, et al., provide a rolling bearing having a long life and an excellent seizing resistance by providing a range of hardness, a carbide grain size and a hardness distribution that are optimum to the improvement of the rolling fatigue resistance and an increase of the rolling bearing life. Also, Matsumoto, et al., provide a rolling bearing which is also excellent in

dimensional stability by providing an optimum average concentration of the residual austenite (10% or less by volume).

On the other hand, in the present invention, the amount of the residual austenite in the raceway ring or the rolling element is 0% by volume over the entire cross section of the raceway ring or the rolling element, and the amount is not changed along the direction of the thickness in the cross section of the raceway ring or the rolling element. Accordingly, dimensional change of the rolling bearing by the martensitic transformation is removed to improve the rotational accuracy of the rolling bearing and the impact absorbing energy is increased. Also, even if the amount of residual austenite over the entire cross section of at least one of the inner ring, the outer ring and the rolling element is 0% by volume, since the surface hardness is HRC of 62 or more, the impact resistance of the bearing is improved so that the acoustic life is improved and the rolling fatigue life is extended.

Because of the significant difference in the amount of residual austenite, the rejection of Claims 1, 2, and 4 should be withdrawn. Claims 6-10 are allowable because of the distinction of the lower limits of the Si and Mn content.

Since all the claims are clearly in condition for allowance and distinguish over the prior art of record, whether taken singly or in combination, an early Notice of Allowance is in

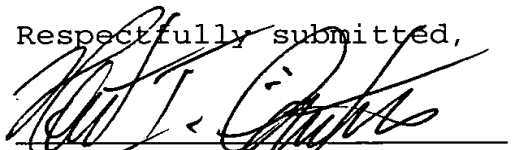
order and the same is most earnestly solicited. If there are any questions regarding this Amendment or the application in general, a telephone call to the undersigned would be appreciated.

If there are any questions regarding this amendment or the application in general, a telephone call to the undersigned would be appreciated since this should expedite the prosecution of the application for all concerned.

If necessary to effect a timely response, this paper should be considered as a petition for an Extension of Time sufficient to effect a timely response, and please charge any deficiency in fees or credit any overpayments to Deposit Account No. 05-1323 (Docket #313MC/48531).

Respectfully submitted,

May 4, 2001



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APPENDIX

Please amend Claims 1-4 as follows:

1. (Amended) A rolling bearing in which at least one of an inner ring, an outer ring and a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring, the outer ring and the rolling element is 0% by volume and a surface hardness is HRC of 62 or more.

2. (Amended A rolling bearing in which at least one of an inner ring[,] and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume and a surface hardness is HRC of 62 or more, and in which [the] a rolling element is formed of a steel material containing alloy ingredients each within a range of C:0.3 to 0.6% by weight, Si:0.3 to 1.5% by weight, Mn:0.3 to 1.7% by weight, Cr:0.5 to 2.5% by weight and Mo:0.6 to 3.0% by weight, with the O content

being 9 ppm or less, applied with carbo-nitridation and then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the rolling element is 0% by volume and a surface hardness is HRC of 62 or more.

3. (Amended) A rolling bearing in which at least one of an inner ring[,] and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite is 0% by volume and a surface hardness is HRC of 62 or more, and in which the rolling element is formed of a maltensitic steel, applied with hardening/tempering and then applied with nitridation to form a nitride layer at a thickness of 3 μm or more on the surface and then applied with finishing to a surface roughness of 0.1μm Ra or less.

4. (Amended) A rolling bearing in which at least one of an inner ring and an outer ring is formed of a steel material containing alloy ingredients each within a range of C:0.8 to 1.20% by weight, Si:0.60% by weight or less, Mn:0.25% by weight or less, Cr:1.00 to 1.50% by weight and Mo:0.60 to 1.50% by weight, then applied with hardening/tempering, the amount of residual austenite over the entire cross section of the one of the inner ring and the outer ring is 0% by volume and a surface hardness is HRC of 62 or more, and in which a rolling element is formed of ceramics.